GENERAL PURPOSE SENSORS

- Insulated Body with Extension Leads
- Straight Metal Tube Body with Extension Leads
- Metal Tube Body and Transition Hub with Extension Leads
- Hypodermic Needle Body with Extension Leads
- Metal Tube Body and Straight Thread Hub with Extension Leads
- Metal Tube Body and Tapered Thread Hub with Extension Leads
- Metal Tube Body and Armored Sheath Over Extension Leads
- Metal Tube, Tapered Thread Hub Body and Armored Sheath Over Extension Leads
- Adhesive Mounted Surface Sensors with Extension Leads
- Bolt Mounted Surface Sensors with Extension Leads
- Bolt Mounted Air/Gas Sensors with Extension Leads
- Rolling Surface Temperature Sensors with Extension Leads
- Printed Circuit Board Air/Gas Sensors
- Glass-to-Metal Seal/Transistor Base Sensors
- Machined Screw Sensors with Extension Leads
- Tapered Pipe Plug Sensors with Extension Leads

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GENERAL PURPOSE SENSOR ASSEMBLIES

Data

The data that follows can be applied to all general purpose sensor assemblies. The housings, hardware and mounts shown in this catalog are suitable for a wide variety of temperature measurement and control applications and can be used with either NTC or PTC thermistors.

There are several application specific product sections in the front of this catalog that showcase typical sensor assemblies that have been designed to meet the requirements of those applications. The remainder of the sensor assemblies shown in this catalog are suitable for general purpose temperature measurement or control applications.

Each type of general purpose sensor assembly will have a listing of possible options. This makes it easy for the user to "custom" design a sensor that satisfies their requirements while using the basic sensor building blocks described in these data tables.

Of course, not all possible combinations of options will be available or even compatible. Likewise, other materials, options or features not shown in the data tables may be available. It is recommended that the user consult the Thermometrics Applications Engineering Department for design assistance when it is desired to change one or more of the options or features of a sensor assembly.

Dimensions and Tolerances

Unless otherwise specified, all dimensions shown in the following drawings or tables are expressed in inches. Wherever possible the metric equivalent shall also be provided.

As a general guide, the following basic tolerances may be used except where otherwise indicated or where industry standards take precedence (e.g.; pipe threads).

a)	one place decimals	± 0.03"
b)	two place decimals	± 0.01"
c)	three place decimals	± 0.005"
d)	fractional (under 1")	± 1/64"
e)	fractional (under 3")	± 1/32"
f)	fractional (under 6")	± 1/16"
g)	fractional (under 12")	± 1/8"

h) wires, cables and armored sheaths — the dimension listed is the MINIMUM length.

How To Specify

When specifying a complete sensor assembly for a given application, the user must choose both a thermistor and an appropriate sensor package.

The complete electrical and mechanical specifications for each thermistor type are given in the product data sheets for that type. The user must use this data to choose a thermistor which is suitable for the application. Such features as size, nominal resistance, tolerance, power rating, etc., must be considered as part of the design process.

Once the appropriate thermistor has been selected, the user must then choose the type of sensor package. The information contained in each section of general purpose sensor assemblies provides the dimensions and design data for the various types of enclosures or housings.

It is important to note the maximum external dimension of the thermistor sensor and the minimum internal dimension of the desired enclosure or housing to be sure that there is no size conflict. There should also be sufficient clearance between the two dimensions in order to allow for electrical insulations and encapsulating materials.

In certain cases, the customer may provide special materials or components to Thermometrics, Inc. for inclusion in a custom assembly. Such customer supplied materials may provide savings in time, expense or both for special orders. Please contact our Applications Engineering Department for additional information and assistance regarding materials selection and/or customer supplied materials or hardware.

Maximum Temperature Rating

The maximum temperature for continuous operation of the thermistor can be found in the product data sheets for each thermistor type. Normally, this temperature will be higher than the temperature rating on such items as the wire insulation, encapsulation materials, shrink tubing or plastic materials.

The general purpose sensor assemblies will have a maximum temperature that is consistent with the materials selected in the design of the sensor. For special assemblies where high or low temperature conditions will be experienced, it is desirable to contact our Applications Engineering Department to insure that materials are selected which can satisfy the conditions.

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Abbreviations used in Sensor Listings

INSULATING / ENCAPSULATING MATERIALS:

CTFE	Chlorotrifluoroethylene
FEP	Fluorinated Ethylene Propylene
PE	Polyethylene
PUR	Polyurethane
PVC	Polyvinylchloride
RTV	Room Temp. Vulcanizing Silicone
SIL	Silicone Rubber
TFE	Polytetrafluoroethylene

CONDUCTOR ALLOYS:

BC	Bare Copper
BCW	Bare Copperweld
Ni	Nickel
Ni200	Nickel Alloy 200
Ni270	Nickel Alloy 270
NPC	Nickel Plated Copper
OFHC	High Conductivity Copper
SCCW	Silver Coated Copperweld
SPC	Silver Plated Copper
TC	Tinned Copper

METALS AND FINISHES:

ALUM	Aluminum
ALUM+AU	Aluminum with Gold Iridite Finish
AU	Gold
AU/KOVAR	Gold Plated Kovar
BeCu	Beryllium Copper
ETP	Electro Tin Plated Copper
Ni/KOVAR	Nickel Plated Kovar
NP PH.BRZ	Nickel Plated Phosphor Bronze
NP STEEL	Nickel Plated Steel
SN STEEL	Hot Tin Dipped Steel
SS	Stainless Steel (304 typical)
TW SS	Thin wall stainless steel tubing
XXSS	Special thin wall stainless steel tubing

Tubing

Tubing: Stainless Steel

The most versatile and useful metal tubing listed in the Catalog is stainless steel. Tubing is available in hypodermic gauge sizes from #6 (.230" O.D.) to #25 (.020" O.D.) in alloy T304. Standard fractional tubing (ASTM A269) and close tolerance fractional tubing (ASTM A632) is available in alloys 304 or 316 as seamless or welded stock. Other series 300 or 400 alloys, special wall sizes and metric sizes can be specified for custom assemblies.

The basic sizes most commonly used in the Catalog listings are shown in the following table.

STANDARD FRACTIONAL SS TUBING

(ASTM A269)

Size	O.D.	WALL	I.D.(ref.)
1/32"	.0313 ± .002"	.006 ± .0009"	.019"
1/16"	.0625 ± .002"	.008 ± .0012"	.047"
3/32"	.0938 ± .003"	.016 ± .0024"	.062"
1/8"	.1250 ± .003"	.010 ± .0015"	.105"
5/32"	.1563 ± .003"	.016 ± .0024"	.124"
3/16"	.1875 ± .004"	.016 ± .0024"	.156"
7/32"	.2188 ± .004"	.016 ± .0024"	.187"
1/4"	.2500 ± .004"	.020 ± .0030"	.210"

CLOSE TOL. FRACTIONAL SS TUBING

(ASTM A632)

Size	O.D.	WALL	I.D.(ref.)
1/32"	.0313 + .002/-0"	.006 ± .0006"	.019"
1/16"	.0625 + .002/-0"	.008 ± .0008"	.047"
3/32"	.0938 + .003/-0"	.016 ± .0016"	.062"
1/8"	.1250 + .003/-0"	.010 ± .0010"	.105"
5/32"	.1563 + .003/-0"	.016 ± .0016"	.124"
3/16"	.1875 + .004/-0"	.016 ± .0016"	.156"
7/32"	.2188 + .004/-0"	.016 ± .0016"	.187"
1/4"	.2500 + .004/-0"	.020 ± .0020"	.210"

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HYPODERMIC SS Tubing

(FED GGN-196)

Gauge	O.D.	WALL	I.D.(ref.)
24XX	.0220 + .0005/-0”	.003 +0/-.0003”	.016”
22TW	.0280 + .0005/-0”	.004 +0/-.0003”	.020”
21TW	.0320 + .0005/-0”	.005 +0/-.0003”	.022”
20TW	.0355 + .0005/-0”	.005 +0/-.0003”	.0225”
19TW	.0425 ± .0005”	.005 ± .0005”	.0325”
18TW	.0500 ± .0005”	.004 ± .0005”	.042”
17TW	.0590 ± .0005”	.0065 ± .0005”	.046”
16	.0650 ± .0005”	.009 ± .0005”	.047”
15	.0720 ± .0005”	.009 ± .0005”	.054”
14	.0830 ± .001”	.010 ± .001”	.063”
13	.0950 ± .001”	.012 ± .001”	.071”
12TW	.1090 ± .001”	.009 ± .001”	.091”
11	.1200 ± .001”	.013 ± .001”	.094”
10	.1340 ± .001”	.014 ± .001”	.106”
9	.1480 ± .001”	.015 ± .001”	.118”
8	.1650 ± .001”	.015 ± .001”	.135”
7	.1800 ± .001”	.015 ± .001”	.150”
6	.2030 ± .001”	.015 ± .001”	.173”

METRIC SS Tubing

Size	O.D.	WALL	I.D.(ref.)
1 mm	1.00+0/-0.05mm	0.20 + 0.03/-0	0.59mm
2 mm	2.00+0/-0.05mm	0.40 + 0.06/-0	1.19mm
3 mm	3.00+0/-0.08mm	0.50 + 0.08/-0	1.98mm
4 mm	4.00+0/-0.08mm	0.50 + 0.08/-0	2.98mm
5 mm	5.00+0/-0.10mm	0.50 + 0.08/-0	3.98mm
6 mm	6.00+0/-0.10mm	0.50 + 0.08/-0	4.98mm

Tubing: Aluminum

Aluminum tubing is available in diameters of 1/8”, 3/16” and 1/4” and with standard wall thickness of .020” to .035”. Alloy D6061-T6 is a commonly specified material and is available in the following sizes:

SIZES:	O.D.	I.D.	WALL
1/8”	.125”	.085”	.020”
3/16”	.187”	.1435”	.022”
1/4”	.250”	.194”	.028”

Tubing: Brass

Brass tubing is available in fractional sizes of 1/16” to 1/4” diameter with the wall thickness being 1/64” or 1/32”. The most commonly specified alloy is #330. Special precision tubing diameter and wall thickness that ranges from .012” to .065” (as appropriate) may be available upon special order. The basic sizes of alloy #330 which are commonly used are as follows:

SIZES:	O.D.	I.D.	WALL
1/16”	.0625”	.0313”	.156”
3/32”	.0938”	.0625”	.0156”
1/8”	.125”	.0625”	.0313”
5/32”	.1563”	.0938”	.0313”
3/16”	.1875”	.125”	.0313”
7/32”	.2188”	.1563”	.0313”
1/4”	.250”	.1875”	.0313”

Tubing: Other Metals

Support tubings for assemblies can be specified from other alloys or metals upon special order and subject to availability. Some common tubing materials which are available for special orders are as follows:

Copper

Hastalloy C

Inconel 600

Monel 400

Nickel 200

Titanium

Tubing: Rigid Plastics and Insulators

Support tubings for assemblies can be specified from rigid plastic formulations or insulation materials that are commercially available in the form of cast or extruded tubes. Rod stock can also be selected, however, machining costs will make these selections more costly. Some common materials which are available as tube or rod stock are as follows:

ABS

Acetal

Acrylic

Fluoroplastic - CTFE

Fluoroplastic - FEP

Fluoroplastic - TFE

Nylon

Phenolic

Polycarbonate

Polyethylene

Polypropylene

Polystyrene

Polyurethane

PVC, rigid

Polyvinylidene-Fluoride

Reinforced Laminates

Cast Epoxy

Steatite

Kraft Paper

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Tubing:

Flexible Plastics, Elastomers and Insulator Sleeves

These materials can be used to provide electrical insulation over circuit interconnections or they may be used to provide electrical insulation and environmental protection over the thermistor and extension leads. The sleeve may be cemented into position with adhesives or some may be heat shrunk into position as required. Protective sheaths may be open ended or they may be sealed by heat, solvents or adhesives depending upon the type of material selected.

The following are commonly used flexible plastic tubings, elastomeric tubings or insulating tubings which may be specified:

INSULATING SLEEVES

- Fiberglass, natural
- Fiberglass, silicone impregnated
- Kapton
- Nomex
- Polyimide

ELASTOMERS

- Buna-N
- Neoprene
- Silicone Rubber
- Silicone, medical grade
- *Viton®

EXTRUDED TUBINGS (NON-SHRINK)

- Polyethylene, radiopaque, medical
- Polyethylene, non-radiopaque, medical
- Polyvinylchloride (PVC)
- Polyurethane
- Teflon - FEP
- Teflon - TFE
- Tygon
- Vinyl, medical grade

SHRINK TUBINGS

- Kynar
- Mylar
- Polyolefin, irradiated
- Polyolefin, adhesive wall
- PVC, irradiated
- Teflon - FEP
- Teflon - TFE
- Polyethylene
- Neoprene, irradiated
- Silicone Rubber

Sensor Tip Styles and Closures

Tubings used for immersion probe assemblies may have various open or closed tip styles depending upon the size and material selected. The most common tip styles are shown in the options listing for each assembly type. Other tip styles may be specified, subject to availability, from the listing as follows:

Open Tip - Thermistor exposed.
Open Tip - Thermistor recessed, fully encapsulated.
Open Tip - Thermistor recessed, machined cross cuts.
Open Tip - Thermistor recessed, milled slots.
Open Tip - Thermistor recessed, drilled holes.
Open Tip - Thermistor recessed, sharpened point.
Closed Tip - Spherical tip, self welded.
Closed Tip - Spherical tip, controlled wall.
Closed Tip - Pointed, tapered.
Closed Tip - Flat plug, welded or brazed
Closed Tip - Machined internal drill point.
Closed Tip - Sharpened, Beveled point.

*Viton is a registered trademark of Dupont Dow Elastomers.

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Encapsulants and Adhesives

The materials selected for encapsulation or bonding must be compatible with the environmental conditions which will be encountered. Temperature extremes and exposure to solvent or chemicals are important considerations when designing a custom assembly. For best results, contact our Applications Engineering Department for materials selection assistance.

The standard encapsulating materials and adhesives include RTV/Silicone Rubber compounds, one and two part epoxy systems and ceramic cements.

Coatings

Various coatings can be provided for additional protection against the effects of moisture, solvents or chemicals. Lacquers, varnishes, liquid epoxy resins, polyurethanes, vinyls and silicones are commonly used for dip coatings or sprayed finishes on various special assemblies.

Hardware: Housing Bodies

Bodies for surface mount assemblies can be constructed of any metal or machinable non-metal. They may also be molded as required. Transition hubs and bodies for immersion assemblies can be machined, molded or swaged as required.

The designer is restricted only by temperature ratings of materials used to construct the housing body and dimensional limits and tolerances which are imposed by industry standards or good design practices.

Hardware: Threads

Threaded bodies for surface sensor mount assemblies and threaded hubs for immersion assemblies are available in all standard sizes and classifications. The most common threaded bodies and hubs are listed below. Other threads and thread lengths may be specified for custom assemblies except that thread diameters and pitches must conform with industry standards.

NEF/UNEF:	NPT:
12-32	1/16-27
1/4-32	1/8-27
5/16-32	1/4-18
3/8-32	3/8-18
7/16-28	1/2-14
1/2-28	

NC/UNC:	NF/UNF:
4-40	4-48
5-40	5-44
6-32	6-40
8-32	8-36
10-24	10-32
12-24	12-28
1/4-20	1/4-28
5/16-18	5/16-24
3/8-16	3/8-24
7/16-14	7/16-20
1/2-12	1/2-20

METRIC

M6 x 1.00

M8 x 1.25

M10 x 1.50

M12 x 1.75

M14 x 2.00

Extension Leads

Extension leads are available in many conductor alloys, gauge sizes, insulations and constructions. Obviously, not all combinations are readily available and not all combinations are suitable for certain assemblies. The physical dimensions, electrical characteristics and thermal properties of an extension lead or cable must be given appropriate consideration in any special design problem.

The wires and cable which are listed below represent the most common extension leads. Most are stocked at Thermometrics, Inc. to expedite delivery on assemblies, whether the assembly is a standard or a custom design. Other wires and cable may be specified, however, this often involves a minimum purchase of wire and therefore should only be considered when the quantity of assemblies to be manufactured is reasonably large.

Leads: Magnet Wire

Magnet wires are small gauge, unplated, solid conductors with thin insulation coatings. Their small size makes them ideally suited for small bead or small probe thermistor assemblies. The most commonly available magnet wire selections are listed in the Catalog for small bead or small probe assemblies.

The listing below gives some typical materials and constructions for magnet wires. Please check with the factory for availability.

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CONSTRUCTION:

Single conductor
Twisted Pair
Bifilar (parallel)
Multifilar

GAUGE SIZES:

#32AWG to #44AWG (solid)

ALLOYS:

Nickel 200
Nickel 270
Copper
Alloy 180
Platinum
SS304
Gold/Platinum alloy

INSULATIONS:

Polyester-imide
Polyurethane
Polyurethane/Nylon
Teflon
Enamel
Polyimide

Leads: Flat Twin Lead, Ribbon Cable

Flat twin lead or ribbon cables are larger than the magnet wires and are usually stranded conductors with the heavier wall insulations. They are used on medium to large size assemblies.

The following listing gives some typical materials and constructions for these cables. Please note that not all combinations are available. Check factory for availability.

GAUGE SIZES:

Flat Twin #18 - #24 (stranded)
Ribbon #28 - #32 (stranded)

ALLOYS:

Bare Copper
Tinned Copper
Silver Plated Copper

INSULATIONS:

PVC
Teflon - TFE
Kynar

Leads: Hook-up Wire

Hook up wire extension leads are the most basic type of assembly termination. The leads are normally larger gauge sizes and are stranded, plated conductors with heavy wall insulation. They are used in medium to large assemblies and provide an easy solder or splice connection to external circuitry.

Thermometrics, Inc. maintains stock on many of the wire types, particularly Teflon and PVC insulated hook up wires. Other hook up wire constructions may be ordered for custom assemblies as desired. Note that not all combinations are available. Please check with factory for availability.

GAUGE SIZES:

#18 - #32 (solid or stranded)

INSULATIONS:

Teflon - TFE
Teflon - FEP
Polyvinylchloride - PVC
Silicone Rubber
Polyimide
Fiberglass
Polyethylene
Polyalkene
Fluorocarbon/Polyimide
Kynar
Tefzel
Thermoplastic elastomer

ALLOYS:

Bare Copper
Tinned Copper
Silver Plated Copper
Nickel Plated Copper
OFHC Copper
Nickel
Dumet

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Leads: Shielded/Jacketed Cables

Some applications require the use of shielded or unshielded cables. The assemblies using such cables will require either a transition hub or a fairly large body to accommodate the size of the cable. The Catalog lists the commonly available cable selections for each assembly type. Note that not all combinations are available. Please check with factory for availability.

GAUGE SIZES:

#20AWG TO #32AWG

CONSTRUCTION:

RG coaxial cable
1 conductor + shield
2 conductors w/ or w/o shield
3 conductors w/ or w/o shield
4 conductors w/ or w/o shield

INSULATIONS:

Teflon - TFE
Teflon - FEP
Polyethylene
Neoprene
Silicone Rubber
Fiberglass

ALLOYS:

Bare Copper
Copperweld
Tinned Copper
Nickel Plated Copper
Silver Plated Copper
Silver Clad Copperweld

Terminations/Connectors

The standard termination is a length of extension leads or cable which is cut and stripped.

Virtually any connector, plug, receptacle or terminal may be added to the sensor assembly as required by the customer to interface the sensor with their electrical circuit or instrument system.

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